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The Role of Boron in the Growth and Productivity of Broccoli

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Abstract: Eating broccoli decreases the prevalence of illnesses in general. It is one of the major plants whose consumption has lately grown due to its high nutritional content and wonderful flavor. Among the most significant contributors to yield enhancement is the foliar application of microelements, particularly boron. The soil is characterized by basicity, which fixes many elements, especially micronutrients, and thus reduces the readiness of nutrients for the plant. As a result, foliar fertilizer spraying is the most effective approach to supplying micronutrients to plants. Boron is an essential mineral for plant development and production. It plays an important function in moving food from the leaves to storage regions, and sugars that combine with boron travel faster than polarised ones.

Key words: Broccoli, boron, NPK, foliar fertilizer, productivity, growth.

Future Science Association

Available online free at
www.futurejournals.org

Print ISSN: 2687-8151

Online ISSN: 2687-8216

DOI:
10.37229/fsa.fja.2024.02.07

Received: 15 December 2023
Accepted: 15 January 2024
Published: 7 February 2024

Publisher's Note: FA stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

دور البورون في نمو وانتاجية البروكلي

نهي وليد قادر – نغم صلاح سالم – سحر علي كلو

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الخلاصة: تناول البروكلي يقلل من انتشار الأمراض بشكل عام ، وهو من النباتات الرئيسية التي زاد استهلاكها في الآونة الأخيرة بسبب محتواه الغذائي العالي ونكهته الرائعة ، من بين أهم العوامل المساهمة في تحسين المحصول هو التطبيق الورقي للعناصر الدقيقة ، وخاصة البورون، تتميز التربة بالقاعدية التي تثبت العديد من العناصر وخاصة العناصر الصغرى وبالتالي تقلل من جاهزية العناصر الغذائية للنبات، ونتيجة لذلك فإن رش الأسمدة الورقية هو الأسلوب الأكثر فعالية لتزويد النباتات بالمغذيات الدقيقة، البورون هو معدن أساسي لتطوير وإنتاج النبات، فهو يلعب وظيفة مهمة في نقل الطعام من الأوراق إلى مناطق التخزين ، والسكريات التي تتحد مع البورون تنتقل بشكل أسرع من السكريات المستقطبة .

الكلمات الدالة: البروكلي ، البورون ، التسميد الورقي ، الإنتاجية ، النمو الخضري.

Introduction

Broccoli, scientifically known as *Brassica oleracea* var. Italica is an annual herbaceous plant that falls under the Brassicaceae family. It is a winter vegetable produce that bears a resemblance to cauliflower. It is grown for its inflorescences, which are eaten when still in the vegetative flower bud stage, and for its heads, which are used in pickles or boiled, fried, or green **(Thapa and Rair, 2012).** Pink curd is distinguished by its substantial nutritional content, with 0.3 lipids, 3.6 grams of protein, 32 calories, 5.9 grams of carbohydrates, and 89.1 grams of water per 100 grams of fresh weight. It is a food low in free fats and sodium and is a source of vitamins such as vitamin C. A, D, carotenoids, folic acid, riboflavin, and niacin **(Michaud *et al.*, 2002)**. Broccoli is regarded as a complete pharmacy since it belongs to the sulfur family, like cabbage and cauliflower, and it contains antioxidants that minimize the risk of cancer. It has been called a superfood, as it consists of foodstuffs that increase natural chemicals that limit the incidence of cancer and break the link between the causes of the tumor and its final stage. This is what made specialists call for the importance of including it in a healthy diet. Broccoli sprouts have been used. They sprout quickly and contain a high percentage of active substances and oils that work to increase the plant's resistance to diseases and increase the percentage of natural antioxidants, especially sulforaphane. Consuming certain plant-based vegetables, such as broccoli, may limit your PMS risk, diabetes, heart disease, and general risk. The consumption of broccoli, which is distinguished by its nutritional value and distinctive taste among international varieties, has increased recently **(Jing *et al.*, 2011)**. One of the most important processes that lead to increasing yield is the use of foliar spraying, as there are soils characterized by alkalinity that stabilize many elements, especially micronutrients, and thus reduce the readiness of nutrients for the plant. Therefore, foliar spraying of nutrients is the appropriate way to provide plants with micronutrients. Boron is considered one of the micronutrients. It is essential for plant development and production, as well as for carrying food from the leaves to storage places. Sugars travel faster after combining with boron than polarised boron. It also has an important role in cell division and elongation, and the lack of its availability negatively affects the plant. Therefore, it is believed that its deficiency is related to the death of the growing shoots, in addition to its effect on the vital activities of the cell through its combination with boron. Hydroxyl compounds involved in the composition of walls are often found in soil in the form of boric acid (H_3BO_3) and may be dissolved in the soil solution or absorbed in the form of borates on the surfaces of clay colloids **(Al-Sahhaf, 1989)** It also exists in the form of borates in different forms: BO_{3-3}, HBO_{3-2}, $H2BO_{-3}$, $B4O7_{-2}$, and $B(OH)_4$, and it determines plant **growth (Acquaah, 2002)** and **(Alloway, 2004)**. Plants require small amounts of boron, and it is essential for the development of cell membranes. Its function is to facilitate the transfer of photosynthesis products from the foliage to active plant regions, including the transportation of carbohydrates, which is critical for cellular division **(Travena, 2007)**. Its presence increases the plant's resistance to drought, and boron deficiency causes brown curd and physiological imbalance as a result of nutritional imbalance **(Hassan, 2004).**

Bishnu *et al.* (2004) indicated that boron was used on cauliflower plants at levels of 0, 5, 10, 15, 20 and 25 kg. h^{-1} of borax at a level of 25 kg. h^{-1} led to a significant increase in plant height by 42.05 cm and the number of leaves by 12.73 leaves. $Plant^{-1}$.

Adhikary *et al.* (2004) observed when studying the effect of adding boron in the form of Borax to the soil at levels 0, 5, 10, 15, 20, and 25 kg. h^{-1} on cauliflower crop grown in acidic soil in Nepal. Increased boron concentrations had a significant impact on the vegetative growth characteristics, including leaf length, number of leaves, and plant height. as fertilization provided 25 kg of borax. h^{-1}

The highest plant length reached 42.05 cm, an increase of 13.95%, and the largest number of leaves was 12.73 leaves. plant^{-1} compared to the comparison treatment.

Monnerzmann *et al.* (2007) revealed that the addition of 1.5 kg h^{-1} boron to broccoli plants results in a leaf count increase.

Lashkari *et al.* (2007) cited the findings of **Hegazy and Abdel-Bary (2008)** in Egypt concerning the effects of potassium fertilization and foliar spraying with boron added in the form of boric acid at concentrations of 0, 25, 50, and 75 mg. L^{-1} and three times (20 days after transplanting and with a 15-day interval between each spraying) on two cauliflower varieties, Snowball and Sultana. It was observed that the spraying treatment with boron resulted in a notable enhancement of the characteristics above of the cauliflower plants. Similarly, the application of boron spraying did not yield a statistically significant impact on the quantity of external leaves. However, as the boron concentration increased to 50 mg L^{-1}, there was a noticeable rise in the nitrogen content of the leaves.

Fayrouz *et al.* (2008) found that adding boron to the soil in an amount of 2.1 kg. One h of broccoli plants produced significant differences in plant height of 62.5 cm and number of leaves per plant of 14.3 leaves.

Hussain *et al.* (2012) detected that when boron was added at levels of 0.5, 1, and 1.5 kg. h^{-1} for broccoli plants caused significant differences in plant height of 65.50 cm.

Al-Rashidi (2012) found that when spraying with boric acid (17.4% Boron), three varieties of cauliflower at concentrations of 30 and 60 mg. L^{-1}. There were no significant differences between plants treated and untreated with boric acid at both concentrations in the characteristics of the speed of emergence of flower curds and the percentage of chlorophyll in the leaves.

Silva *et al.* (2016) used three levels of boron: 1, 1.5, and 2 mg. L^{-1} boron does not affect the chlorophyll content in the leaves, but it had a significant effect in increasing the leaf area and dry matter production in the broccoli plant shoot.

AL_Bayati (2019) observed that boron application at a concentration of 30 mg killed cauliflower plants. Moreover, L^{-1} induces substantial variations in both the leaf area and the number of leaves per plant.

Al-Husseini (2019) revealed that the vegetative growth characteristics measured by plant height, number of leaves, leaf area, percentage of dry matter in the leaves, and relative chlorophyll content in the leaves (spad) were not significantly affected by boron (boric acid) spraying at concentrations of 0, 100, or 200 mg/L.

Singh *et al.* (2002) found that four levels of borax were used by adding soil to cauliflower plants: 0, 0.5, 1.0, and 2.0 kg. ha^{-1} month after planting seedlings, add 1.0 kg. h^{-1} gave the highest marketing yield for heads.

Khadaka *et al.* (2005) confirmed that adding borax in an amount of 20 kg. One h increased the head yield of cauliflower plants by 14.3 - 13.9 tons. h^{-1} was found for two consecutive **Varghese and Duraisami (2005)** when boron was added in an amount of 1.0 kg. One h on cauliflower plants increased the yield by 28.79 tons. h^{-1}.

Monirnzzaman *et al.* (2007) found that adding boron at a level of 1.5 kg. h^{-1} on broccoli plants led to an increase in head weight and head yield. **Firoz *et al.* (2008)** found that adding boron in an amount

of 2.1 kg. h^{-1} of broccoli plants caused significant differences in the weight of the plant yield, 518.3 g, and the total yield of heads, 14.5 tons/h^{-1}.

The results of **Hegazy and Abdel-Bari (2008)** for two seasons 2002 and 2003 in Egypt and for the cauliflower varieties Snowball and Sultani showed that spraying leaves with boric acid three times, 20 days after transplanting, and with an interval of 15 days between one spray and another, sprayed with a concentration of 50%. L^{-1} in the two seasons of the experiment caused significant differences in body length, curd weight, and total curd weight per ton. Acre-1, Increased spraying to 75 mg. L^{-1} significantly decreases the yield and its components.

Saha *et al.* (2010) reported that spraying broccoli plants with boric acid at a rate of 2% and 3% 30 and 60 days after transplanting led to significant differences in flower stem length and diameter, and the total plant yield and head yield of 13.37 tons. h^{-1}, average head weight and protein content in heads, which amounted to 3.24 g/100 g.

Al-Rashidi (2012) mentioned that when spraying with boric acid (17.4% Boron) for three varieties of cauliflower at concentrations of 30 and 60 mg. L^{-1}. There were no significant differences between plants treated and untreated with boric acid at both concentrations in yield characteristics and total curd weight.

Hussain *et al.* (2012) observed when adding boron at levels of 0.5, 1, and 1.5 kg. h^{-1} for broccoli plants caused significant differences in head diameter of 13.32 cm, head yield of 274.4 g, and total head yield of 10.15 tons. h^{-1}.

Rakhsh and Golchin (2012) found that when broccoli plant heads were treated with three different amounts of boron in the form of boric acid (0, 1.7, and 3.5 kg.h-1), the overall yield increased.

Ibrahim (2015) discovered that foliar spraying broccoli plants with boron at two doses of 30 and 60 mg. L^{-1}. The majority of yield parameters showed significant variation across boron treatments. Flower curd weight and overall yield.

AL_Bayati (2019) said that cauliflower plants were sprayed with boron at a dosage of 30 mg. L resulted in substantial changes in head weight, head diameter, total head yield, dry matter percentage, and nitrogen and boron percentages in heads.

We find that spraying boron improves the nutritional condition of broccoli plants, hence increasing their growth and production.

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